

Amended claims:

1 1. **(original)** An apparatus for determining at least one
2 orientation parameter of an elongate object having a tip
3 contacting a surface at a contact point, said apparatus
4 comprising:

5 a) a projector on said elongate object for illuminating
6 said surface with a probe radiation in a predetermined
7 pattern from a first point of view;

8 b) a detector on said elongate object for detecting a
9 scattered portion of said probe radiation returning
10 from said surface to a second point of view;

11 c) a unit for determining said at least one orientation
12 parameter from a difference between said probe
13 radiation and said scattered portion.
14

1 2. **(original)** The apparatus of claim 1, wherein said at
2 least one orientation parameter comprises an
3 inclination angle θ between an axis of said elongate
4 object and a normal to said surface at said contact
5 point.
6

1 3. **(original)** The apparatus of claim 2, wherein said
2 at least one orientation parameter further
3 comprises a roll angle ψ around said axis.
4

1 4. **(original)** The apparatus of claim 1, wherein said
2 surface comprises a plane surface.

1 5. **(original)** The apparatus of claim 1, wherein said
2 predetermined pattern comprises an asymmetric pattern.

1 6. **(original)** The apparatus of claim 5, wherein said
2 asymmetric pattern is selected from the group
3 consisting of line sets, ellipses, rectangles and
4 polygons.

1 7. **(original)** The apparatus of claim 1, wherein said
2 projector comprises a structured light optic for
3 projecting said probe radiation onto said plane
4 surface in said predetermined pattern.

1 8. **(original)** The apparatus of claim 7, wherein said
2 structured light optic comprises at least one
3 element selected from the group consisting of
4 holographic elements, diffractive elements,
5 refractive elements and reflective elements.

1 9. **(original)** The apparatus of claim 1, wherein said
2 elongated object is selected from the group consisting

3 of jotting implements, pointers, robotic arms and
4 canes.

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1 10. **(original)** The apparatus of claim 9, wherein said
2 jotting implements are selected from the group
3 consisting of pens, pencils and styluses.

4
1 11. **(currently amended)** An apparatus for determining at least
2 one orientation parameter of an elongate object having a
3 tip contacting a plane surface, and a normal to said
4 plane surface, said apparatus comprising:

5 a) a projector on said elongate object for illuminating
6 said plane surface with a probe radiation at an angle
7 σ to ~~said~~ an axis of said elongate object;

8 b) a detector on said elongate object offset from said
9 projector for detecting a scattered portion of said
10 probe radiation returning from said plane surface at a
11 predetermined scatter angle τ to said axis;

12 c) a timing unit for deriving said at least one
13 orientation parameter from a detection time of said
14 scattered portion.

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1 12. **(currently amended)** The apparatus of claim 11, wherein
2 said at least one orientation parameter comprises an
3 inclination angle θ between ~~an~~ said axis of said

4 elongate object and a normal to said surface at said
5 contact point.
6

1 13. **(original)** The apparatus of claim 12, wherein said
2 at least one orientation parameter further
3 comprises a roll angle ψ around said axis.
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1 14. **(original)** The apparatus of claim 11, further
2 comprising a scanning arrangement for varying said
3 angle σ in a scan pattern.
4

1 15. **(original)** The apparatus of claim 14, wherein said
2 scanning arrangement comprises a uniaxial scanner
3 for varying said angle σ by introducing an x-
4 deflection γ_x .
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1 16. **(original)** The apparatus of claim 14, wherein said
2 scanning arrangement comprises a biaxial scanner
3 for varying said angle σ by introducing an x-
4 deflection γ_x and a y-deflection γ_y .
5

1 17. **(original)** The apparatus of claim 14, wherein said
2 scanning arrangement comprises a biaxial scanner
3 for varying said angle σ and said scan pattern is
4 selected from the group consisting of raster scan

5 patterns, line scan patterns and Lissajous
6 figures.
7

1 18. **(original)** The apparatus of claim 11, wherein said
2 projector comprises a structured light optic for
3 projecting said probe radiation onto said plane
4 surface in a predetermined pattern.
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1 19. **(original)** The apparatus of claim 18, wherein said
2 structured light optic comprises at least one
3 element selected from the group consisting of
4 holographic elements, diffractive elements,
5 refractive elements and reflective elements.
6

1 20. **(original)** The apparatus of claim 18, wherein said
2 predetermined pattern is selected from the group
3 consisting of line sets, ellipses, rectangles and
4 polygons.
5

1 21. **(original)** The apparatus of claim 11, wherein said
2 projector is mounted above said detector.
3

1 22. **(original)** The apparatus of claim 11, wherein said
2 detector further comprises a narrow field angle
3 reception unit for admitting to said detector only

4 said scattered portion returning from said plane
5 surface at said predetermined scatter angle τ .

6
1 23. **(original)** The apparatus of claim 22, wherein said
2 narrow field angle reception unit is selected from
3 the group consisting of a cylindrical lens, a
4 collimating lens, a thick aperture, a system of
5 apertures, and a slit.

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1 24. **(original)** The apparatus of claim 11, wherein said
2 detector comprises a photodetector array.

3
1 25. **(original)** The apparatus of claim 24, further
2 comprising a centroid computation unit for
3 determining a centroid of said scattered portion.

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1 26. **(original)** The apparatus of claim 11, further
2 comprising an optic for shaping said probe radiation
3 into a scan beam.

4
1 27. **(original)** The apparatus of claim 11, wherein said
2 elongated object is selected from the group consisting
3 of jotting implements, pointers, robotic arms and
4 canes.

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1 28. **(original)** The apparatus of claim 27, wherein said
2 jotting implements are selected from the group
3 consisting of pens, pencils and styluses.
4

1 29. **(original)** The apparatus of claim 11, wherein said
2 timing unit is located on said elongate object.
3

1 30. **(original)** The apparatus of claim 11, wherein said
2 projector comprises a single frequency emitter for
3 emitting said probe radiation at a single frequency f.
4

1 31. **(original)** A method for determining at least one
2 orientation parameter of an elongate object having a tip
3 contacting a surface at a contact point, said method
4 comprising:

5 a) illuminating said surface with a probe radiation in a
6 predetermined pattern from a first point of view on
7 said elongate object;

8 b) detecting a scattered portion of said probe radiation
9 returning from said surface at a second point of view
10 on said elongate object;

11 c) determining said at least one orientation parameter
12 from a difference between said probe radiation and
13 said scattered portion.
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1 32. **(original)** The method of claim 31, wherein said
2 predetermined pattern is a scan pattern.
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1 33. **(original)** The method of claim 31, wherein said
2 predetermined pattern comprises an asymmetric pattern.
3

1 34. **(original)** The method of claim 31, wherein said at
2 least one orientation parameter comprises at least one
3 Euler angle.
4

1 35. **(original)** A method for determining an inclination angle θ
2 between an axis of an elongate object having a tip
3 contacting a plane surface, and a normal to said plane
4 surface, said method comprising:

- 5 a) providing a projector on said elongate object;
- 6 b) providing a detector on said elongate object, said
7 detector being offset from said projector;
- 8 c) illuminating said plane surface with a probe radiation
9 at an angle σ to said axis from said projector;
- 10 d) detecting a scattered portion of said probe radiation
11 returning from said plane surface at a predetermined
12 scatter angle τ to said axis with said detector;
- 13 e) a timing unit for deriving said inclination angle θ
14 from a detection time of said scattered portion.
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1 36. **(original)** The method of claim 35, wherein said angle σ
2 is varied in a scan pattern.

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1 37. **(original)** The method of claim 36, wherein said
2 scan pattern is selected from the group of
3 uniaxial scan patterns and biaxial scan patterns.